WATER PURIFICATION

Subject: Science | **Current:** 2010 | **Grade:** 9-12 **Day:** 2 of 3

1 Purpose

To create a cost-effective mobile water purification kit to be used in case of a natural disaster.

2 Duration

50 minutes

3 Additional Topics

Water Pollution and Health Issues

4 Objectives

At the conclusion of this lesson, students will be able to:

- Create a water purification kit to be used in the event of a natural disaster
- Provide alternative water purification methods in the event of a natural disaster
- Compare the cost of the water purification kit with the quality of the kit

5 Standards Addressed

ENVIRONMENTAL SCIENCE

Understand and describe that if a disaster occurs – such as flood or fire – the damaged ecosystem is likely to recover in stages that eventually result in a system similar to the original one. **ENV.1.2**

Recognize and explain that the amount of life any environment can support is limited by the available energy, water, oxygen, and minerals, and by the ability of ecosystems to recycle organic materials from the remains of dead organisms. **ENV.1.14**

Identify natural Earth hazards, such as earthquakes and hurricanes, and identify the regions in which they occur as well as the short-term and long-term effects on the environment and on people. **ENV.1.33**

EARTH AND SPACE SCIENCE

Investigate the causes of severe weather and propose appropriate safety measures that can be taken in the event of severe weather. **ES.1.16**

HEALTH & WELLNESS

Examine how the environment and health are connected. **HW.1.3**

Indiana Department of Education. (n.d.). Indiana Standards and Resources: Sciences: Environmental Science and Earth Space Science; Health & Wellness. Retrieved from http://dc.doe.in.gov/Standards/AcademicStandards/StandardSearch.aspx

6 Vocabulary

- **Water Purification**: Multi-step process to remove contaminants from surface or groundwater to make it safe for human consumption
- **Filtration**: Used for the separation of solids from fluids by allowing fluids to pass, but the solids are retained
- **Sedimentation**: The action of depositing sediment suspended in a liquid
- **Slow Sand Filter**: The use of course sand and other granular media to remove particles and impurities.
- **Flocculation**: The use of chemicals to cause particles in liquids to aggregate (forming a floc)
- **Chlorination**: The process of adding chlorine to water
- **Ultraviolet Light**: Sterilization methods that uses UV light to break down micro-organisms
- **Activated Carbon**: A form of carbon used for adsorption or chemical reactions with water contaminants
- **Distillation**: The process of purification through vaporization and condensation

7 Materials

- Possible supplies to build a water purification kit such as sand, socks, Ziploc baggies, wood, straws, coffee filters, iodine, bleach, plastic cups, plastic tubing, sheets of plastic, rocks, soil, cotton balls, screwdriver, bleach, and duct tape

8 Additional Resources

- Water Purification Lab Handout
- Water Purification Lecture Notes
- Water Purification Visual Aid – http://www.grainmills.com.au/prod87.htm
- Water Purification Visual Aid – http://express.howstuffworks.com/gif/exp-lifestraw-diagram.jpg
- Water Purification Lab Rubric

9 Methods & Procedures

The lesson plans course is as follows:

A. Introduction

In the event of an emergency, such as a natural disaster, the best strategy is to have an emergency plan in place with an emergency kit; however, sometimes the best intentions are not always possible. During Hurricane Katrina, the residents affected may or may not have had an emergency plan in place, but despite their intentions, the plan was dismissed and merely trying to survive took over.

Despite efforts taken to store enough water and food in the event of an emergency, a tornado or hurricane could easily wipe out the storage supplies. Survival mode must kick in and safe drinking water must be sought out in case the arrival of help is delayed. There are many types of water purification kits in the market today ranging in costs and sizes. The likelihood of having any of the water purification kits on hand in the case of a natural disaster is very unlikely; therefore, the ability to create a water purification system in order to provide safe drinking water is a necessity.

There are several methods of purifying water including boiling, adding bleach or iodine, and filter through sand or even soil. The idea behind purifying the water is to eliminate contaminants such as particles, parasites, bacteria, algae, viruses, fungi, and other organic materials.

B. Development

After the introduction, provide students with the Water Purification Kit Handout. Discuss the different supplies available to the students. A photo of a water purification kit can be shown to provide suggestions to the students. Students must consider the following questions when creating the system:

- Of the supplies provided, how accessible are the items in the event of the disaster?
- Is the water purification kit easy to transport?
- Is the water purification kit cost-effective?

C. Independent Practice

Students will get into groups of four to research a variety of water purifying kits in order to create a water purification kit to provide safe drinking water in the event of a natural disaster. Students can use the following resources to begin their research:

- http://consumerwaterpurificationsystems.com/
- http://www.aquatechnology.net/system_comparisons.html
- http://www.allergybuyersclub.com/learning/home-treatment-systems.html

Students need to consider the following questions while conducting research:

- Which process is the most effective?
- Which process is the most practical to carry out in the event of a natural disaster?
- How mobile is the item in the event of an emergency?

Students should be given approximately 15 minutes to complete this activity.

D. Practice

Students will get into groups of four to create a water purification kit to provide safe drinking water in the event of a natural disaster. The effectiveness of water purification kit will be tested in the next lesson. When constructing the water purifier, students need to consider:

- What items will be used in the model and explain why?
- What purpose does each item serve in the purifying process?
- How practical are the items included?
- How mobile is the item in the event of an emergency?

Students should be given approximately 25 minutes to complete this activity

E. Accommodations (Differentiated Instruction)

- Some students may need to draw or computer generate the model before beginning to build it. Students with visual or mobility issues may need support during the building phase. Advanced students may be charged with building the most cost effective model for both personal use and family use.

F. Checking for understanding

- Students will be asked to explain the water purification process.
- Students will be asked to discuss the reality of creating a kit in the aftermath of a natural disaster.
- Students will be asked to identify which contaminants will be eliminated from the water purifier.
- Students will be asked to discuss the advantages and disadvantages of the different water purification methods.

G. Closure

Careers Involved in Water Purification:

- U.S Geological Survey or Agricultural Research Service – http://www.usgs.gov
- U.S. Bureau of Reclamation – http://www.usbr.gov/
- Bureau of Land Management – http://www.blm.gov/
- U.S. Army Corps of Engineers – http://www.usace.army.mil/
- U.S. Forest Service – http://www.fs.fed.us/
- Natural Resources Conservation Services – http://www.nrcs.usda.gov/
- U.S. Environmental Protection Agency – http://www.epa.gov/

10 Evaluation

Students will be evaluated by their individual role in the creation of the water purification kits, the completion of the lab handout and in the group discussion.

11 Teacher Reflection

To be completed by teacher following the lesson

12 Media & Resources

- http://www.grainmills.com.au/prod87.htm - Water Purification Diagram
- http://express.howstuffworks.com/gif/exp-lifestraw-diagram.jpg - Water Purification Diagram
- http://www.bionewsonline.com/s/what_is_water_purification.htm
- http://www.natureskills.com/water_purification_process.html

- http://www.bae.ncsu.edu/programs/extension/publicat/wqqm/emergwatersuppl.html
- Possible supplies to build a water purification kit include: sand, socks, Ziploc baggies, wood straws, coffee filters, iodine, bleach, plastic cups, plastic tubing, sheets of plastic, rocks, soil, cotton balls, screwdriver, and duct tape.
- Water Purification Lab Handoutgoes here
- Water Purification Lecture Notes
- Water Purification Lab Rubric
- U.S Geological Survey or Agricultural Research Service – http://www.usgs.gov
- U.S. Bureau of Reclamation – http://www.usbr.gov/
- Bureau of Land Management – http://www.blm.gov/
- U.S. Army Corps of Engineers – http://www.usace.army.mil/
- U.S. Forest Service – http://www.fs.fed.us/
- Natural Resources Conservation Services – http://www.nrcs.usda.gov/goes here
- U.S. Environmental Protection Agency – http://www.epa.gov/ goes here
- U.S. Bureau of Reclamation – http://www.usbr.gov/

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WATER PURIFICATION NOTES

- Reason – to eliminate contaminants such as organic particles, parasites, bacteria, viruses, fungi, and toxic metals such as lead, copper, and chromium
- Methods –

1. Physical Processes
   a. Filtration (Soil and Sand)
   b. Sedimentation
2. Biological Process
   a. Slow Sand Filters
   b. Activated Sludge
3. Chemical Processes
   a. Flocculation
   b. Chlorination
   c. Ultraviolet Light

- Other Methods –

1. Boiling (At least 5 minutes)
   a. Advantage – easy to do
   b. Disadvantage – does not treat all possible contaminants
2. Liquid Bleach (1 part bleach to 100 parts water)
   a. Advantage – cheap and easy to perform
   b. Disadvantage – does not treat all contaminants and can be dangerous if consumed in the wrong amounts
3. Distilling
   a. Dig a hole and surround the hole with concrete blocks or rocks on three sides of the hole. The hole with house the created heat source.
   b. Place three rocks around the hole in the shape of a tripod.
   c. Place a cooking pan with the contaminated water over the heat source and place an empty cooking pan on the outside of the concrete wall.
   d. Place a piece of sheet metal in a see-saw manner on top of the concrete wall.
   e. As the water starts to boil, steam with rise to the sheet metal, condense, and run down the sheet metal into the empty cooking pan.

WATER PURIFICATION LAB

You and your group members have just survived a hurricane, but your home has been destroyed as well as your emergency food and water supplies. Your group needs to consider the different types of water purification systems to obtain safe drinking water. Your group must build a water purifying kit in order to survive until help arrives. Your group has collected the following supplies:

- Sand
- Straws
- Plastic Tubing
- Sticks
- Socks
- Coffee Filters
- Straws
- Duct Tape
- Soil
- Iodine
- Sheets of Plastic
- Ziploc Bags
- Bleach
- Rocks
- Wood
- Plastic Cups
- Cotton Balls

As you create the water purification system, please answer the following questions:

1. List the step-by-step process used to create the water purifier.

2. How did your group determine which items to use in the purification kit? List each item, explain why it was chosen, and describe its purpose in the purification process.

3. Draw a diagram of your group's water purifier.

4. Which step of the purification process do you think makes the most difference? Why?

RUBRICK FOR WATER PERFORMANCE LAB

	5 Points	3 Points	1 Point
The group listed the step-by-step process used to create the water purifier	Completely	Some components were omitted	Many components were omitted
The group listed each item, explained why it was chosen, and described its purpose in the purification process.	Completely, including list, explanation, and description.	Some components were omitted.	Many components were omitted.
The group drew a diagram of its water purifier .	Completely, including labeling.	Some components were omitted.	Many components were omitted.
The group explained which step of the purification process they thought made the most difference.	Thoroughly, excellent rationale provided.	Good explanation, reasonable rationale provided.	Poor explanation. No rationale provided